Rappahannock River
Fisheries Management Report
2004

The Rappahannock River is one of Virginia's top destinations for smallmouth bass angling, canoeing and camping along an almost completely unspoiled historical river corridor. The character of this river changes abruptly in Fredericksburg at the fall line (the limit of tidal influence) literally beneath U.S. Route 1. Above this point, the river is typically clear, swift, and dominant substrates are bedrock, boulder and cobble – perfect habitat for smallmouth bass, rock bass, redbreast sunfish and related species. Virginia designates the entire nontidal portion of the Rappahannock River at a 'State Scenic River'. Below U.S. Route 1, the river is tidal, the substrate is finer – dominated by sand, and the water is frequently murky. Species composition shifts with habitat, and largemouth bass, catfish and anadromous species are common in and below Fredericksburg. A short distance above the fall line, Embrey Dam blocks the path of migratory species. Work has recently begun to remove this deteriorating impoundment and restore a free-flowing river - allowing passage of migratory fish to over 100 miles of historic spawning grounds. Dredging of accumulated silt from behind Embrey Dam began in summer, 2003, and the dismantling of the structure should begin in 2004.

Investigations of the fisheries resources of the Rappahannock system are usually stratified between tidal and non-tidal because of the noted differences in habitat and associated fish communities. This report concerns the non-tidal system – a similar report of the tidal Rappahannock River is due in March 2006 and will feature fisheries components such as largemouth bass, anadromous species (American shad, hickory shad, blueback herring, alewife and striped bass) and the catfish community.

Access to the Rappahannock system (defined here as the Rapidan and Rappahannock Rivers) is limited and fairly primitive. Established access points on the Rappahannock (traveling downstream) are at Kelly's Ford (Route 672 off Route 651) in Culpeper County and Motts Landing (Route 618) in Spotsylvania County. About 25 miles separates these canoe/jon boat slides, and an overnight camp stop is nearly mandatory for those that float fish this reach. Another access point is located on the Rapidan River at Elys Ford (Route 610) in Spotsylvania County about 14 miles upstream of Motts Landing. This access has a concrete slab boat ramp, but attempting to launch trailered boats is not recommended. It is, however, an excellent canoe access point. A primitive and steep access point is available along the Department's Raccoon Ford property downstream of Route 522 along Route 611 (right-hand bank). Access may also be gained via several "non established" points – these consisting of VDOT rights-of-ways along bridges (e.g., Routes 3 and 522 on the Rapidan and Route 29 on the Rappahannock). Parking may be a problem in the latter cases, and many anglers choose one of the canoe liveries that have agreements with landowners and provide floats of varying length from access points not available to the general public. For more information, contact Clore Brothers (540-786-7749), Rappahannock Outdoor Education Center (540-371-5085) or Rappahannock River Campground (800-784-7235). The City of Fredericksburg owns much of the riparian land along the river, so finding a suitable campsite is rarely a problem.

Fisheries management on the Rappahannock system prior to 1996 consisted of occasional electrofishing samples on different sections of the rivers, as biologists' time was concentrated

managing and investigating fisheries resources in lakes and reservoirs. However, emphasis shifted, and a more intensive effort was initiated to gather base-line data on smallmouth bass and other important riverine fish populations. Annual multi-station electrofishing began in 1996 and has continued through 2003. Generally, four sites on the system are sampled by boat electrofishing for all fish species each fall. One sampling site is located below Embrey Dam (Laucks Island), while three sites are located above Embrey Dam: I95 (just above Embrey), Elys Ford (middle Rapidan River) and Phelps WMA (below Kelly's Ford on the upper Rappahannock). Additionally, more intensive depletion electrofishing with multiple boats was conducted at these four sites during summer 2001 – a technique involving the sequential removal of individuals from within a known area with multiple vessels. This survey allowed Rappahannock River fish population estimates and biomass calculations for the first time and is discussed in greater detail below.

The first Rappahannock creel survey was conducted in 1998. The creel survey was duplicated in 1999 because of a drought that began in late spring, 1998. Unfortunately, the drought worsened in 1999. Creel surveys are valuable because they provide fisheries managers with the "human component" of the fisheries equation – e.g., estimates of angler preferences, success and harvest (versus sampling by electrofishing which is the best way to obtain biological data about fish populations). Based on creel surveys, it is conservatively estimated that the Rappahannock system annually supports about 24,000 angler visits totaling nearly 100,000 hours of fishing pressure. The majority of anglers surveyed (67%) targeted smallmouth bass, but only 1% of bass caught were harvested.

Fisheries studies in the Rappahannock River have included all species but focused primarily on smallmouth bass due to its importance as a game fish. As with other species, three primary factors govern the density and size structure of the smallmouth bass population: recruitment, growth and mortality.

One of the most important factors governing smallmouth bass population size is recruitment or year class strength (the number of individuals spawned in a given year that survive to become part of the population). Year class strength is a function of many variables including both biotic and abiotic (e.g., environmentally related) and can fluctuate dramatically from year to year (Figure 1). Data have shown that a large amount of variability associated with year class strength can be attributed to spring river flows - primarily average flows during June. This post-spawn month seems to be critical in determining the outcome of a year's spawn, as too much or not enough water impede recruitment. Flows of around 200-500 CFS (average June flow in cubic feet per second from the Culpeper gauge) seem to provide good spawns, but recruitment drops rapidly after about 600 CFS suggesting high flows are more damaging than low flows. The drought of 1999 resulted in a fair year class (83 CFS), while flooding during spring 1995 and 1996 (2,901 and 923 CFS) resulted in nearly complete spawning failures. Generally, spring flows from 1997 through 2002 were moderate, and recruitment was average during this period (including 2002 which marked the beginning of another major drought). The record year class of 1997 continues to drive the smallmouth fishery, as its contribution to the population was still very obvious in the 2003 electrofishing sample. Anglers should benefit from the trophy production of this strong year classes for several more years. When smallmouth bass experience good spawning, the average size of young fish is often significantly higher than in years when fewer individuals are produced. This suggests that competition between bass is not occurring (at least during the first year) and that the same variables that favor high reproduction also favor growth of young fish. This knowledge, combined with population estimates derived

from depletion sampling (discussed below), has enabled biologists to devise an experimental stocking plan to supplement smallmouth bass numbers after multiple years of poor reproduction. A Rappahannock River stocking of about 20,000 smallmouth bass fingerlings will be attempted in summer 2004. These hatchery reared fish will have small tags to differentiate them from wild fish, and no fish will be stocked in the Rapidan River, which will serve as a control for the system.

The second feature of smallmouth bass population dynamics – growth – is relatively slow in the Rappahannock River (Figure 2). For example, the following sizes corresponded to fish aged 0-3 (fish were collected in fall, so an additional growing season had elapsed – e.g., an "age 1" fish was actually about 1.5 years old): 4.1", 6.9", 8.5" and 9.9". Age 5 smallmouth bass (six growing seasons) averaged only 13.1". These averages were compiled from fish aged between 1996 and 2002 and were accomplished with otoliths (or 'ear stones') that provide much more accurate age estimates than scales. Suffice it to say that it takes a long time for a smallmouth bass to reach citation length of 20". Forage may be a limiting factor, as many of the smallmouth bass stomachs examined during survey periods were empty or contained only detritus. Most of prey items that could be identified were redbreast sunfish. Other items commonly encountered (in decreasing abundance) included crayfish, aquatic insects such as stoneflies and hellgrammites, terrestrial insects and darters. Fish passage at Embrey Dam will provide Rappahannock smallmouth bass with a larger and more diverse forage base.

In addition to slow growth, smallmouth bass seem to be experiencing high mortality. The portion of the population that is removed each year (total annual mortality) is made up of fishing and natural mortality. Total annual mortality of Rappahannock smallmouth has been estimated between about 40% and 80% depending on year class (a group of fish spawned the same year) and age. Some of the most statistically significant total annual mortality estimates were for the 1997 and 1998 year classes (58% and 51% for ages 1-4). This represents a fairly high mortality rate, and it is believed (based on creel surveys) that most of the mortality is natural, as harvest averaged just 1% of smallmouth bass caught during creel years. However: harvest of large fish may be disproportionate, as an average of 56% of registered citations were kept between 1995 and 2003 (Figure 3). Fishing *related* mortality (e.g., delayed hooking mortality) may also be a factor.

Electrofishing surveys indicated that abundance of smallmouth bass (the number captured per unit effort or CPUE - in this case, an hour) increased from 1996 through 1999, leveled off, and then dropped through 2003 (Figure 4). Year class strength was responsible for a great deal of the variability in CPUE (since much of the population was composed of only two or three year classes at any given time), but some of the variability may have been a function of sampling conditions. Generally, there was an inverse relationship between river stage and CPUE – likely because fish were more vulnerable to electrofishing in shallower conditions and when confined to small pockets of water.

The size distribution of the smallmouth bass population (as defined by the index Relative Stock Density of Preferred fish, or RSD-P - a ratio of adult fish that were 14" or greater) changed little between 1996 and 2000 but fluctuated thereafter (Figure 5). Simply stated, the higher the RSD value, the higher the percentage of large fish in the population (14" is the nationally accepted standard for "preferred" size smallmouth bass). Like many factors, population size structure was largely dictated by year class strength, and the record 1997 year class contributed heavily to the high RSD-P value observed in 2003.

Abundance of smallmouth bass was fairly consistent among sampling sites except that densities were lower in the reach below Embrey Dam. Only 39 preferred fish (14" and over) were captured during eight years of electrofishing at all sites (out of 1,801 smallmouth bass sampled). This suggests that either large fish were scarce, or our gear was biased against collecting larger individuals, perhaps due to seasonal variability (or a combination of both). Citation records indicate that the former may be the case. In the early 1990s, prior to 1996 when citations were only credited by weight (five pounds for smallmouth bass), an average of three citations were submitted annually. Citations increased after fish could be registered by length (20" minimum), but submissions averaged only 14 since 1996 (not including the Rapidan). The top three months for catching trophy smallmouth bass were August, September and February; however, seasonal breakdowns were nearly consistent between spring, summer and fall. A supplemental smallmouth bass electrofishing survey was conducted at all four sites during spring 2000 to determine if fall surveys provided a seasonal bias against larger fish. Although spring average sizes were slightly higher when compared to preceding and following fall surveys, differences were minimal and not statistically significant. About 100 smallmouth bass collected during the spring runs were also tagged at two sites to provide some indication of relative movement. Fifteen returns were received (all in the first two years) and suggested very limited movement of the tagged fish. Most were caught at the tagging site, while one had moved upstream about two miles during spring. Four of the tag returns were from DGIF surveys, and anglers provided the balance (all were released except one).

Harvest restrictions were recently placed on several Virginia smallmouth bass populations in other rivers (large slot length limits with reduced creels or "trophy" regulations). A similar regulation was evaluated for the Rappahannock River but discounted due to 1) slow growth of Rappahannock River smallmouth bass, 2) marginal population model yield, 3) high voluntary release rate, 4) high angler satisfaction with current regulations, 5) absence of a small, ineffective slot limit, and 6) limited access with which to establish a section that could be evaluated.

Smallmouth bass grow more slowly in the Rappahannock River than in other large Virginia Rivers (e.g., age 4 fish averaged almost 13" in the James River and well over 12" in the New River but only 11.6" in the Rappahannock River). Thus, it takes substantially more time for fish to reach a given size in the Rappahannock River, during which time more bass succumb to high annual mortality. It is believed that most of this mortality is related to natural causes and not fishing, and this slow growth combined with high natural mortality would severely undermine a harvest restriction aimed at protecting large fish.

Potential changes to the Rappahannock River smallmouth bass population were modeled with FAST (Fishery Analysis and Simulation Tool) – a computer program designed to simulate changes to a fishery based on biological parameters under variable harvest restrictions. Output indicated that 59 trophy (>20") smallmouth bass were present in the system under the current regulation (no minimum size). However, a projected change to a 14-20" slot length limit only increased that number to 67 – a marginal 14% increase. It is difficult to justify this change, given the other issues, for an increase of eight fish.

Creel surveys conducted in 1998 and 1999 documented an extraordinarily high voluntary release rate of smallmouth bass (99%). A release rate of this magnitude would negate an attempt to restructure the population with a length limit of any type – the limited harvest would simply not have a population level impact.

Anglers indicated that they were satisfied with the current regulation in the 1998 and 1999 creel surveys. During both surveys, 84% of anglers stated that they were happy with the current regulation – this consistency was noteworthy. Only 12% favored more restrictive regulation in 1998, while 15% in chose this option in 1999. Changing a regulation against the overwhelming majority of users' wishes seems a dubious proposition, especially given the options that are now available to them on other Virginia rivers.

A five fish per day bag limit with no minimum size currently governs smallmouth bass harvest on the Rappahannock River. However, other rivers had small, ineffective slot length limits (e.g., 11-14") prior to the change to a large slot length limit. The failure of these small slot length limits to meet objectives necessitated a need for corrective action. Additionally, higher harvest of large fish was either documented or perceived and should enable the new large slot length limits to more effectively restructure the populations.

Due to limited access on the Rappahannock River, an experimental section with which to test a new regulation would be difficult to enforce. Currently, only three access points are present on the entire system (Elys Ford on the Rapidan, and Kellys Ford and Motts Landing on the Rappahannock). Because anglers typically float from one of the upper landings to Motts, they would potentially travel through water that would be both subject to a new regulation and governed by the old regulation. The alternative would be to change the regulation on the entire river system thereby eliminating any control section to evaluate such a change. In short, the Rappahannock does not lend itself, at this time, to the easy evaluation and enforcement of a regulation change.

Electrofishing gear sampled other popular species in the Rappahannock system including redbreast sunfish and rock bass. In all years surveyed, redbreast sunfish were much more abundant than rock bass. Abundance of redbreast sunfish and rock bass increased higher in the watershed (more were caught at Elys and Kelly's Ford than in Fredericksburg), and rock bass were more abundant in the Rapidan than in the Rappahannock River. Fallfish were abundant in both upper reaches, but largemouth bass were generally confined to waters adjacent to Embrey Dam (sample sites both above and below the dam). Several species were collected at the site below Embrey but were never collected above the dam. These include gizzard shad, channel catfish, white perch, yellow perch, and striped bass. It is noteworthy that no blue catfish were collected at the Embrey sampling site despite their dramatic colonization over the past 20 years in nearby tidal waters.

Data collected during the week of depletion sampling in summer 2001 provided a plethora of opportunities including 1) the estimation of smallmouth bass population size and biomass, 2) further "ground truth" comparisons of fall single-pass electrofishing data, 3) the categorization of species contribution to the overall fish community, and 4) a better (though not comprehensive) species list of the system.

Smallmouth bass population estimates for the Rappahannock River derived from depletion sampling were 621 adult (age 1 and over) and 356 young-of-year per mile. A conservative estimate for total smallmouth bass in the system was about 115,000 fish. Obviously, this figure was subject to a great deal of bias having been computed from only four sample sites; however, it represents a starting point. Similarly, total smallmouth bass biomass (or standing crop) was estimated at about 9 pounds per acre – a value consistent with estimates derived from the James River by DGIF in 2002 and Virginia Commonwealth University in an earlier study.

Size structure parameters of the smallmouth bass population from depletion sampling were compared to samples taken the previous and following fall in an effort to determine if fall single-pass samples were providing accurate representation of true size structure (the assumption was made that depletion electrofishing did, in fact, result in the capture of all sizes of fish present in accurate proportions of their abundance). This and other similar analyses resulted in the production of a technical manuscript, of which a draft is available if desired. Fall single-pass samples appeared to produce bias at two of four sites against the collection of larger fish.

Depletion sampling also allowed the categorization of species composition. The top five species collected by number (with number captured in parentheses) were redbreast sunfish (968), smallmouth bass (484), rock bass (480), northern hogsucker (122) and bluegill (114). Four of these species belonged to the sunfish family indicating the Rappahannock system is "sunfish heavy" – a contrast to other river systems were herring and catfish species comprise a large portion of the community. The top five species collected by weight (with percent contribution to total weight in parentheses) were smallmouth bass (20%), redbreast sunfish (17%), northern hogsucker (12%), white sucker (10%) and rock bass (9%). Additional species collected and their contribution to total weight are listed below (Table 1). These 35 species are by no means an exhaustive list, but are illustrative of a current nontidal Rappahannock River fish community.

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